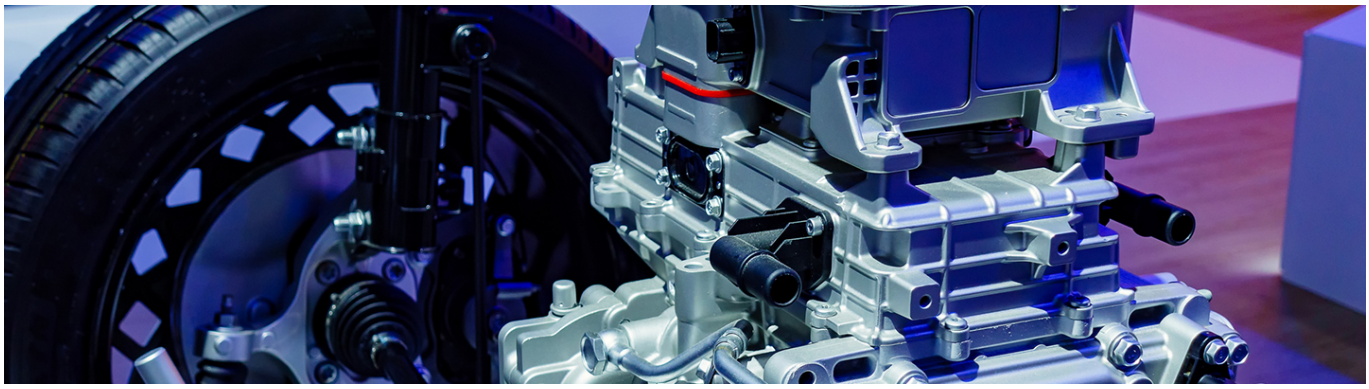


Metalworking

Electric Vehicles: Machining in a World Made of (High-Strength) Steels

Kip Hanson | Jul 18, 2023

First, the facts: Electric vehicles require *only a fraction* of the roughly 1,400 machined components used in internal combustion vehicles.

And the ***200 components*** that are needed are smaller, lighter and must therefore withstand higher levels of torque.

Together, those developments have led to a gradual shift from traditional mild steels and cast irons to stronger alloy steels like 4340 and 8620, as well as increased use of advanced high-strength steels (AHSS) for chassis and body components.

Such metals are a bit tougher, slightly more abrasive, and where machining is concerned, produce longer, stringier chips than their traditional automotive alternatives.

Industry specialists at Sandvik Coromant "expect this shift to include a continued increase in the use of high-strength steels, from around 15 percent of all materials used in automotive manufacturing in 2010 to 38 percent in 2030," ***EV Design & Manufacturing*** reported.

Machining Changes Gears

So buckle up, automotive machinists. What those trends indicate is that you will soon be producing fewer parts for your internal combustion engine (ICE) customers, retooling for electric vehicle (EV) motors and powertrains, and machining increasingly high quantities of metals that wear tools much faster than they have for most of your careers.

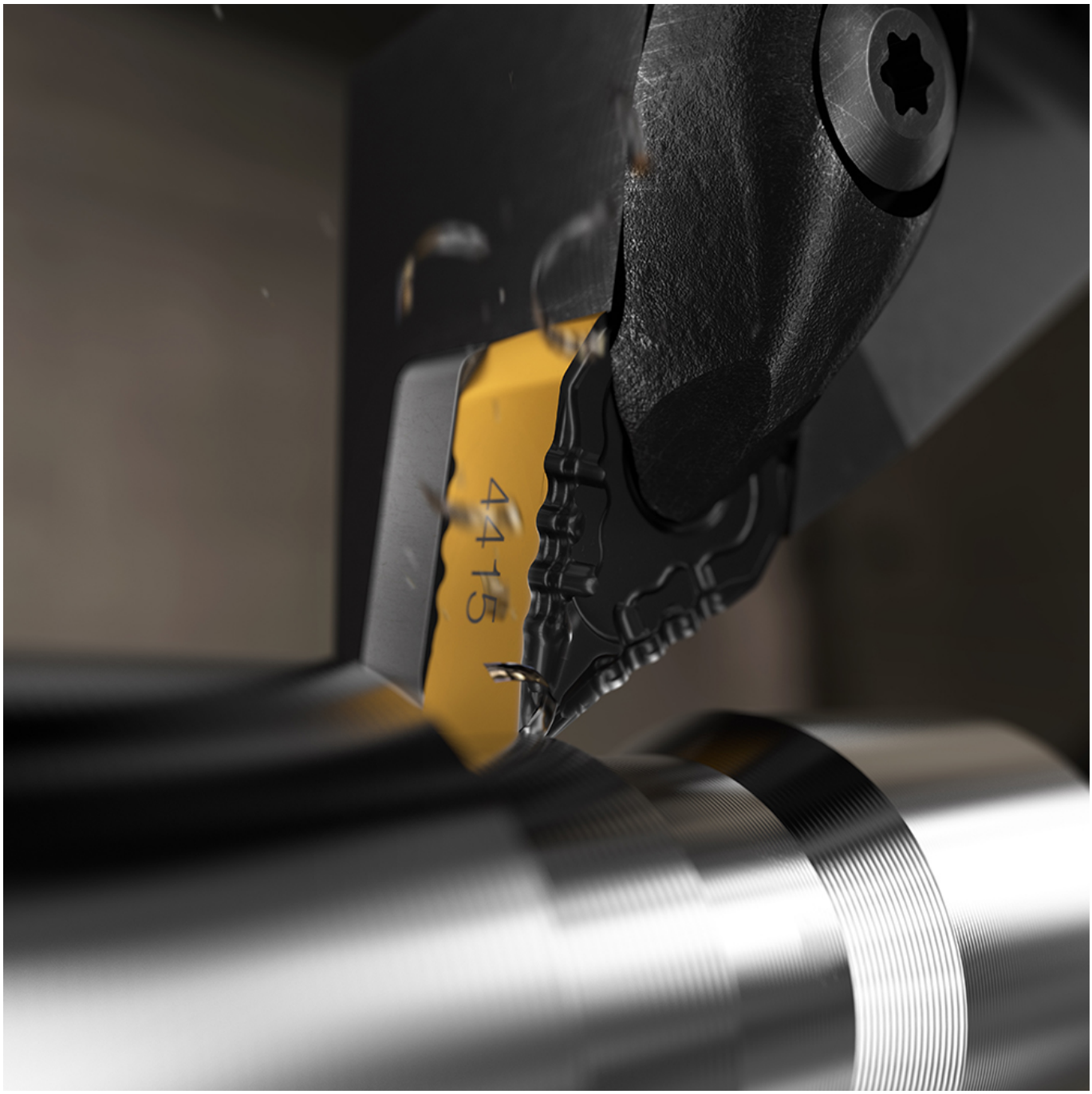
Whether today's projections will hold true long term remains to be seen, but there's little doubt that EV development and sales are on the rise.

During a recent visit to a well-known supplier for numerous automakers, John Winter, Eastern U.S. product manager for Sandvik Coromant, was queried about a new grade of steel, a forged material that the company had chosen for an output shaft. Though not privy to the actual grade, he says it presented notable challenges to achieving chip control.

“Part of the problem was that they’d gone to a different forging supplier, so their tool life was suffering and they couldn’t break the chip consistently,” Winter says. He then made what seemed like a strange suggestion: “It earned me a funny look, but I told them to run it dry.”

Advanced Coating Capabilities

Winter assumed that Sandvik Coromant’s latest generation of Inveio coating would be up to the task, and he was right. Chip control was phenomenal, he says, and judging by the amount of edge wear, he estimated that the customer could increase tool life by at least 30 percent.



Sandvik Coromant’s GC4415 turning grade is tough as well as heat- and wear-resistant, making it suitable for a variety of turning applications. | Photo courtesy of Sandvik Coromant

“Our new steel grades perform extremely well in wet and dry conditions, but I’m finding that if our cut

time on the insert is under 30 seconds, it's better to run dry," Winter says. "With the harder substrates we're now offering and Inveio's extremely fine crystalline structure, it's very effective at pulling heat away from the cut zone. Because of this, we're sometimes able to double tool life by turning off the cutting fluid."

Between Sandvik Coromant's coating advancements and the recent expansion of its bidirectional Prime Turning technology, customers are enjoying greater flexibility and throughput. "I'd also recommend that shops evaluate dynamic turning methods for these and many other materials, which like our Prime offering, leverage the chip-thinning phenomenon for improved tool life," he adds.

A Sales Boom for Toolmakers?

Machinists shouldn't discard legacy equipment and tools yet, however, says Werner Penkert, manager of Global Future Solutions and Global Solutions Engineering at Kennametal Inc.

"There is significant and ongoing development in this space, and while I think that ICE manufacturing will decline somewhat over the next 10 years or so, it probably won't drop to the levels some are suggesting," he says.

That's good news for anyone who sells CNC machinery, transfer lines and cutting tools, many of whom have been dreading the revenue loss that would surely come with automakers transitioning to an electric-only offering.

In the meantime, there's an opportunity over the coming decade for sales growth as manufacturers produce an eclectic mix of electric, internal combustion and hybrid automobiles, the last of which calls for more components per vehicle than the first two combined.

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> Werner Penkert
> Kennametal Inc.

And regardless of what type of engine automakers stick under the hood, all of them are likely to increase their use of high-strength steels and composite materials to make lighter, more energy-efficient vehicles.

"We're also seeing a lot of interest in hydrogen fuel cells, especially here in Europe," Penkert says.

Experience with Inconel, Hastelloy

Penkert notes that Kennametal has had the steel and aluminum that makes up the bulk of all vehicle components "under control for decades."

Since this cutting tool manufacturer, among others, provides machine shops with many excellent grades, coatings and geometries for super-tough metals like ***Inconel*** and ***Hastelloy***, Penkert (and his competitive counterparts) see little difficulty in tackling any newer grades of steel in the electric vehicle market.

Consequently, much of the company's efforts are aimed at providing standardized solutions—a complete tooling package for transmission shafts, for example, or one designed for steering knuckles—each with the ***cutting tools*** and holders needed to be successful in that application.

“It’s nothing new, really,” he says. “In fact, I started in project engineering 26 years ago at Kennametal, and even back then we were offering turnkey packages for various industry segments. So, whether you’re challenged with making traditional powertrain components or the rotors, stators and gearboxes found in the e-mobility sector, we have proven solutions.”

Done in One

Seco Tools takes a similar approach. Strategic Project Manager Peter Wiseman explains that the cutting tool manufacturer’s strategy has long been geared toward the development of tools designed for certain materials or applications—the company’s new TP3501 grade, for example, engineered specifically for interrupted cuts in steel.

“Now, however, we’re focusing more on the development of full solutions for specific components, including those found in EV manufacturing,” he says.

Christian Allen, a business development manager for the automotive segment, agrees with that assessment.

An inspector checks an automotive ring gear on a coordinate measuring machine. | Photo courtesy of Seco Tools

He’s currently working with a customer that needs to tool up for an EV rotor shaft, a project that involves a detailed analysis of all the required machining operations—the rough and finish turning operations, grooving, gear cutting and so on.

“Each carries unique challenges, which the use of ultra-high-strength steels can further complicate,” Allen says.

Note the mention of gear-cutting in the context of turning operations just now. It indicates another growing trend among EV manufacturers: Due to their lower production quantities, they’re less reliant

on dedicated transfer lines and customized equipment, instead using off-the-shelf CNC machinery such as ***multitasking lathes***.

EV manufacturers are discovering what the aerospace and medical industries have long known—that even though multitaskers are much slower than the legacy equipment mentioned a moment ago, they're far more flexible. And because they can complete more operations in a single handling, part accuracy is greater.

"In this particular case, we're collaborating with DMG MORI to produce the component in a single operation, which includes power skiving of the gear," Wiseman says. "That way, handling is minimal, there's less work-in-process, and all the dimensions are right there."

As for the longer cycle times, Seco Tools continues to do what it and many of its competitors have always done in the automotive space: develop specialized tooling able to perform multiple operations in a single pass, a service that will grow in importance as materials become more difficult and workpieces more complex.

"We've long supplied custom form tools, step drills, and the like to our automotive customers, and I don't see this changing in the electric vehicle world," Wiseman says. "Cycle time will continue to play a leading role here, just like it always has."